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University of Kentucky

ADAPTABILITY OF RED CLOVERS FROM DIFFERENT REGIONS, TO KENTUCKY.

BULLETIN NO. 318



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SUMMARY

Much of the clover seed sown in Kentucky is produced in other states and in foreign countries.

Many lots of seed from Kentucky and elsewhere were tested at the Lexington, Princeton and Hopkinsville soil fields, from 1922 to 1930.

Most clovers that have been grown in Kentucky for many years, gave satisfactory production.

Foreign clovers and clovers from other states were more or less unsatisfactory.

Much of the failure of clover in Kentucky is attributable to the use of kinds that are not adapted to local conditions.

The investigation indicates that only clovers that have been tested and are known to be adapted to local conditions should be used.

BULLETIN NO. 318

Adaptability of Red Clovers from Different Regions, to Kentucky

By E. N. FERGUS¹

Over three fourths of the red clover seed sown in Kentucky is produced outside of the state. Much of this seed is obtained from states bordering Kentucky, especially those on the north; most of the remainder comes from states farther north and from the Northwest, altho in certain years since 1900 European seed has probably been sown widely. The proportion obtained from each region varies from year to year, depending upon the amount of seed available for market in the region.

Many samples of seed from different regions have been sown on the Kentucky Agricultural Experiment Station soil fields, and the clovers studied as to length of life and yield. These studies have shown that adapted red clovers survive conditions that kill unadapted kinds; also that the latter sometimes fail to produce two crops the second year. The results of these rather extensive studies of clover adaptation in Kentucky are reviewed in this bulletin.

PLAN OF THE STUDIES

Seed from different regions² was sown in small plots on uniform soil suitable for clover. One of the clovers usually was distributed at frequent intervals thruout the test as a check,

¹ Dr. W. D. Valleau, plant pathologist; Prof. E. J. Kinney, associate agronomist; Mr. H. H. Jewett, entomologist; and Mr. J. F. Freeman, superintendent of soil experiment fields, have generously advised and assisted with the experiments reported in this bulletin. Acknowledgments are also due Messrs. S. J. Lowry and L. M. Caldwell, superintendent and assistant, respectively, of the Western Experiment Substation, Princeton, for the careful execution of details of the experiments conducted there.

² These studies were made cooperatively with Drs. A. J. Pieters and E. A. Hollowell, of the United States Department of Agriculture, who have furnished most lots of seed other than those from Kentucky.

and each of the others generally was sown on duplicate plots some distance apart. In most tests the size of the plots was $1/80$ acre, and the seeding rate varied from 10 to 15 pounds of good seed. Most of the tests were seeded in the spring, on winter wheat land which had been harrowed lightly; two were summer-sown on bare fallow. In all tests the seed was sown broadcast by hand. Stands of plants were determined in the fall and spring, usually by counting the plants on representative areas in each plot. Usually yields of hay were obtained by harvesting representative small areas, because of the necessity of separating weeds and clover. The harvested clovers were weighed green, the moisture content determined, and the air-dry yield later calculated. The earlier tests were confined to the Experiment Station farm at Lexington; later ones were in part duplicated at the Western Experiment Substation at Princeton. Two small tests were made on the Hopkinsville soil field. For reasons explained later the tests are divided into two groups, 1922 to 1925 and 1926 to 1930, inclusive.

THE 1922-1925 TESTS

These tests were made on the Experiment Station farm at Lexington. The first one, consisting of six foreign and four domestic clovers, was sown on winter wheat April 21, 1922. Good stands were obtained, but weeds and a severe drought prevented good growth of the clovers before winter, and all died before spring, 1923.

A second test, sown on fallowed land in August, 1923, included one Italian, eight other foreign, and five domestic clovers. The weather was dry from seeding until November, and the plants made very little growth before winter. The Italian clover winterkilled; others lifted or heaved and died during late winter and early spring.

A third test was sown, in duplicate, in wheat in the spring of 1924. It included two Italian, eight other foreign and five domestic clovers. One of the last group was an Alabama clover obtained direct from a farmer who had grown it successfully in that state for about sixteen years. Excellent stands of all

clovers were obtained and the growth was satisfactory until July, when a severe drought occurred. Some plants on all plots were killed, tho all stands were fairly good on September 19.



Fig. 1. Left, French; center, Italian; right, German; red clovers in the 1924-25 test, Experiment Station farm, Lexington, the last of May, 1925. The Italian clover is a complete failure; the German and French plots have a few clover plants left; most of the material consists of weeds.

All clovers except the Italian wintered successfully. The remainder, except Alabama, Ohio, and Michigan, practically failed during the spring (Fig. 1). While the stands of these three were fair at harvest time, they were not thick enough to make a heavy yield (Fig. 2).

A fourth test, seeded on fallow land September 8, 1925, included one plot each of two Italian, seven other foreign, and eight domestic clovers. The soil was dry at seeding, and germination did not occur until rains came about the middle of September. Good stands were obtained, but the plants made little growth before winter. The Italian, French and Oregon clovers completely winterkilled, and the remainder lost heavily from heaving and winterkilling.

The tests which have been briefly described proved that many kinds of red clover are not reliable in Kentucky. Those from Europe, Chile and northwestern states of the United States were in this group. Since some had failed completely and others had produced fairly good crops the second year in

the third test, it seemed that more extensive tests might discover clovers well adapted to Kentucky, i. e., kinds sufficiently resistant to disease and unfavorable climatic conditions to survive and produce two good crops the second year.

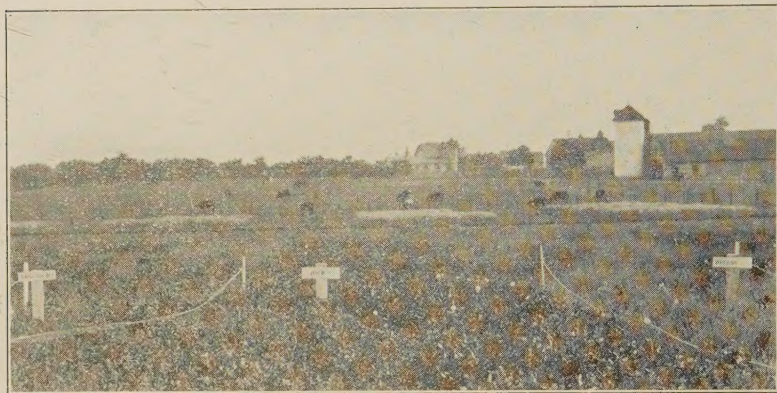


Fig. 2. Left, English; center, Ohio; right, Oregon; red clovers in the 1924-25 test, Experiment Station farm, Lexington, the last of May, 1925. There is practically no clover on the English plot and none on the Oregon. The Ohio is representative of the Michigan and Alabama clovers; note that the stand is uneven.

TESTS FROM 1926-1930

It was noted earlier that the tests beginning in 1926 constituted a new series. Fundamentally they differ from the earlier ones in the nature of the Kentucky clovers included. Two with unknown histories had been studied in the earlier tests but had shown no outstanding adaptability. Since the early tests showed that clovers varied remarkably in ability to maintain stand and yield, it seemed probable that any clover which had been grown for many years on the same farm in Kentucky, or in the same locality, should be well adapted in the state and, therefore, succeed better than most clovers from other states and countries. Consequently, with the assistance of county agricultural agents,³

³ The following county agents or ex-county agents have assisted in obtaining Kentucky-grown red clovers: J. H. Atkerson, G. W. Bacot, Stuart Brabant, John C. Brown, H. M. Christian, C. O. Dickey, J. M. Dyer, H. K. Gayle, R. M. Greene, W. B. Howell, H. R. Jackson, S. J. Jones, Orem LaMaster, R. H. Lickert, J. E. McClure, R. B. McClure, A. G. Middleton, Charles Miller, W. D. Sutton, E. P. Tichenor, C. M. Wade, J. W. Whitehouse, H. W. Whittenburg, R. O. Wilson, and Troll Young.

a search for such clovers was made in leading clover-growing counties in Kentucky during the winter of 1925-26. Eight different lots were obtained. The search was continued from



Fig. 3. Left, Italian; right, Kentucky 101; red clovers in the 1926-27 test, Experiment Station farm, Lexington, on April 28, 1927. The Italian-clover failed during the winter; Kentucky 101 wintered with practically no loss.

year to year, and many more clovers were included in later tests.

More extensive studies of clovers from outside of Kentucky were made also. As the evidence accumulated, it became apparent that differences between clovers from a given region were usually slight in comparison with differences between any one of them and the best Kentucky kinds. Consequently, for convenience and clarity, the clovers are grouped in this bulletin as follows: northwestern states, Oregon, Washington and Idaho; northern states, Michigan, Iowa, Minnesota and Wisconsin; central states, Ohio, Indiana, Illinois and Missouri; southern states, Tennessee, Virginia and Maryland; European (except-Italian and French), Hungarian, Roumanian, German and

Russian; French; and Italian. Canadian clover has always performed similarly to northern domestic clovers and it is reported with them; Chilean performs similarly to French clovers and is reported with that group.

THE 1926-1927 TEST

The eight Kentucky clovers first obtained, with seven other domestic and nine foreign clovers (Table 1), were sown in duplicate plots on the Experiment Station farm at Lexington, March 25, 1926. Good stands were obtained, and relatively little dying occurred during the summer and fall. All domestic clovers except those from northwestern states stood the winter successfully, but European clovers winterkilled severely (Figs. 3, 4). First and second crop yields, reduced to an air-dry basis, are given in Table 1.

TABLE 1. Stands and computed yields of red clovers sown March 25, 1926, on the Experiment Station farm, Lexington, Kentucky.

Group	Percentage Stand ⁴		Yield of Clover Hay (12% moisture) in Lbs. per Acre		
	12/4/26	3/21/27	First Crop	Second Crop	Total
Kentucky 101	100	90	3910	1070	4980
Kentucky 102	100	90	2660	770	3430
Kentucky 103	100	90	3520	940	4460
Kentucky 104	100	90	3800	960	4760
Kentucky 105	100	90	3130	690	3820
Kentucky 106	100	90	4840	700	5540
Kentucky 107	100	90	3290	950	4240
Kentucky 108	100	90	4220	700	4920
Southern clovers (2)	100	90	4135	1370	5505
Central clovers (2)	100	90	3030	855	3885
Northern clovers (2)	100	87	2745	450	3195
Northwestern clovers (1)	100	77	2890	540	3430
European (except French and Italian) (3)	100	46	1160	Failure	1160
French (5)	97	24	2036	292	2328
Italian (1)	86	3 ⁵	Failure	.....	.....

⁴ The 100 percent stands had about 35 plants per square foot.

⁵ All the Italian clover died during the spring.

Italian clover failed to produce a hay crop, and other foreign clovers were inferior to the poorest domestic lots in this test. Domestic clovers from different regions varied somewhat



Fig. 4. Three French red clovers in the 1926-27 test, Experiment Station farm, Lexington, on April 25, 1927. Fall stands on these plots were excellent, but they failed during the winter and early spring. Close observation shows that there are few clover plants left. Compare with Kentucky 101 in Fig. 3. Other European (except Italian) stands winter-killed somewhat less than the French, but the plots appeared much the same at time these photographs were made.

in yield, the southern and a few Kentucky lots being decidedly best. It is of interest that six of the eight Kentucky lots yielded over two tons of hay to the acre (12 percent moisture).

THE 1927-1928 TESTS

Two separate tests were sown in the spring of 1927; one on the Experiment Station farm at Lexington, the other on the Hopkinsville soil experiment field.

Tests at Lexington. This test, sown March 16 and 17, included, in duplicate, nine foreign clovers, four of the Kentucky clovers previously grown,⁶ and nine from other states. All stands were good during the summer and fall, as shown in Table 2, but the northern and northwestern domestic, Kentucky 103, and European clovers almost or totally failed during the winter (Figs. 5, 6, 7). Those from the central and southern states

⁶ Four Kentucky-grown lots sown in 1926 were not included in the 1927 seeding because no seed was available.



Fig. 5. Kentucky 101 red clover in the 1927-28 test, Experiment Station farm, Lexington, June 6, 1928. The plot is practically pure clover. This clover survived the severe 1927-28 winter. Compare with Figs. 6 and 7.



Fig. 6. Michigan red clover in the 1927-28 test, Experiment Station farm, Lexington, June 6, 1928. There are only a few weak red clover plants on the plot; practically everything is weeds. An excellent fall stand failed during the winter. Compare with Fig. 5. This plot was representative of other clovers in this test from northern states.

wintered fairly well, and Kentucky 101 was quite winter-hardy (Fig. 8). Other Kentucky clovers in this test severely winter-killed. These differences in winter hardiness are indicated in Table 2. The clover plants made slow spring growth, and first-crop yields were low, but those from the second crop were relatively better and brought the total to approximately two tons for Kentucky 101 and one and a half tons from the central and southern states. Northern clovers yielded about one third ton.

TABLE 2. Stands and computed yields of red clovers sown March 16 and 17, 1927, on the Experiment Station farm, Lexington, Kentucky.

Group	Percentage Stand		Yield of Clover Hay (12% moisture) as Lbs. per Acre		
	12/1/27	4/2/28	First Crop	Second Crop	Total
Kentucky 101	95	87	2470	1700	4170
Kentucky 103	98	2	Failure	.....	.....
Kentucky 104	94	22	1190	270	1460
Kentucky 105	92	25	1490	290	1780
Southern clovers (2)	98	50	2260	590	2850
Central clovers (3)	100	53	2173	613	2786
Northern clovers (3)	97	22	587	30	617
Northwestern clovers (1) ..	94	Failure	.....	.....	.....
European (except French and Italian) (3)	93	8	Failure	.....	.....
French (5)	93	Failure	.....	.....	.....
Italian (1)	95	Failure	.....	.....	.....

Test at Hopkinsville. This test, which was spring-sown in winter wheat, consisted of two foreign and six domestic clovers, three of the latter being from Kentucky. All original stands were excellent, but fall stands varied considerably and the following spring stands ranged from 5 percent for the Italian to 85 percent for the southern clovers (Table 3). Continued rainy weather prevented harvesting until the Tennessee clover was nearly out of bloom and had lost many of its leaves, which probably accounts for its somewhat inferior yield in comparison with the northern lot (Table 3).

TABLE 3. Stands and yields of red clovers sown in the spring of 1927, on the soil experiment field, Hopkinsville, Kentucky.

Group	Percentage Stand		Yield of Air-dry Hay as Pounds per Acre First Crop
	Fall, 1927	4/7/28	
Kentucky 102	Varied from 60% for Italian to 90% for native clovers. Accurate estimate not made on each plot.	67	4260
Kentucky 103		55	4000
Kentucky 105		25	3650
Southern clovers (1)		85	4390
Northern clovers (1)		55	4630
Northwestern clovers (1)		30	3570
French (1)		22 ⁷	Failure
Italian (1)		5 ⁷	Failure

⁷ These stands failed before harvest time.

THE 1928-1929 TESTS

Tests were seeded in 1928 on the Experiment Station farm at Lexington, the Hopkinsville soil experiment field, and the Western Experiment Substation at Princeton.

Test at Lexington. More different lots were included than in previous tests. It consisted of duplicate plots of fourteen foreign lots and forty-three domestic lots, twenty-two of the latter being Kentucky clovers (Table 4), most of which were reported to have been grown in the state for many years.

Most of the lots were sown March 12; because of rainy weather the seeding of a few was delayed until March 23 and 24. Good stands were obtained on all plots and, as practically all the wheat nurse crop had winterkilled, the clovers made excellent growth. A good hay crop was cut July 12. The plots were not harvested separately, as there were no apparent differences.

Shortly after removal of this hay crop all clovers, except a few of the southern lots, began to die rapidly. Apparently the plants were dying because of drought, but investigation showed that they were being killed by disease (southern anthracnose) and insects (potato leaf hopper).

A study of fall stands recorded in Table 4 shows that northwestern domestic clovers practically failed during the first summer and that the northern clovers fared little better. The



Fig. 7. French red clover in the 1927-28 test, Experiment Station farm, Lexington, June 6, 1928. There is no clover on the plot. An excellent fall stand completely failed during the winter. This plot was representative of other foreign and Kentucky 103 clovers. Compare with Fig. 5.

summer mortality of European clovers was heavy, but the stands were superior to those of the northern and northwestern domestic clovers. Most Kentucky clovers were good or excellent, but several almost failed; none of the latter were old varieties. The stand of Tennessee clover was excellent. Most lots winterkilled more or less, and spring stands of foreign and northern and northwestern domestic clovers were practical or total failures. Stands of clover from the central states were poor. Some Kentucky clovers failed, but several other stands were fair; a few, including Kentucky 101, were good. The stand of Tennessee clover was fair.

The hay crop was unavoidably harvested fully two weeks late. This caused loss of leaves from the southern clovers, many of which nevertheless gave large yields (Table 4). Many plants died after harvest, especially in the remaining stands of foreign and in all lots of domestic clover except the southern clovers. New growth was slow even on the best plots, and the second

crop was not harvested. The differences between the clovers are indicated in Table 4.

TABLE 4. Stands and computed yields of red clovers sown on the Experiment Station farm, Lexington, Kentucky, 1928.

Group	Percentage Stand ^a		Yield of First Crop of Hay (12% moisture) in Lbs. per Acre	Growth After Cutting
	11/7/28	3/28/29		
Kentucky 101	90	75	3970	Good
Kentucky 102	90	45	2280	Good
Kentucky 103	90	45	760	None
Kentucky 104	85	35	460	None
Kentucky 107	95	50	2950	Poor
Kentucky 108	50	45	2870	Poor
Kentucky 109	85	55	3470	Good
Kentucky 110	85	45	3330	Fair
Kentucky 111	70	45	3250	Poor
Kentucky 112	20	20	2520	None
Kentucky 113	5	5	-----	-----
Kentucky 114	15	5	-----	-----
Kentucky 115	10	10	1620	None
Kentucky 116	55	35	2620	Fair
Kentucky 117	90	80	4560	Fair
Kentucky 118	70	25	1700	Fair
Kentucky 119	90	55	4160	Good
Kentucky 120	60	45	2270	Fair
Kentucky 121	95	75	3410	Good
Kentucky 122	5	0	-----	-----
Kentucky 123	90	60	4110	Good
Kentucky 124	90	75	3440	Fair
Southern clovers				
(1)	90	55	1830	Fair
Central clovers (7)	50	16	1426	None
Northern clovers				
(6)	23	3	550	-----
Colorado (1)	50	10	1850	None
Northwestern				
clovers (6)	10	1	-----	-----
European (except				
French and Ital-				
ian) (7)	21	2	240	None
French (5)	34	5	498	None
Italian (2)	25	0	-----	-----

^a The stands rated as 90 percent had approximately 6.5 plants to the square foot.

This test definitely proved that practically all clovers from regions furnishing most seed to Kentucky farmers will fail completely in the state under certain conditions.

Tests at Princeton and Hopkinsville. Identical tests, sown at Princeton and Hopkinsville in the spring of 1928, included one French and six domestic clovers, four of the latter being of Kentucky origin. Original stands were not determined, but probably some were not good at Hopkinsville, since fall stands of Tennessee 1 and Kentucky 107, both good clovers, were inferior. Kentucky 101 had the best fall stand at Hopkinsville and Kentucky 107 at Princeton, while French 2 had somewhat the poorest at each place, as shown in Table 5. Winter changes in stands were not significant except in Wisconsin 2 at Hopkinsville, which almost failed before spring. The clovers were not

TABLE 5. Results of tests of lots of red clover on the Hopkinsville Experiment Field and the Princeton Experiment Substation in March, 1928.

Group	Hopkinsville Percentage Stand ^a		Princeton Percentage Stand ^a		Princeton	
	11/10/28	3/11/29	11/17/28	3/8/29	Computed Yield of Air-dry Hay, Lbs. per Acre, 1st Crop	Growth After Cutting
Kentucky 101	85	75	70	80	4310	Good
Kentucky 104	60	60	70	80	4490	Fair
Kentucky 107	45	30	85	70	4250	Good
Kentucky 111	60	55	70	65	3880	Fair
Southern (1)	40	45	70	80	3680	Good
Northern (1)	40	15	55	65	3680	None
French (1) ..	35	40	50	60	3770	None

^a Stands were obtained by estimating the percentage of perfect ground cover. The clovers were weak when fall stands were estimated, as a result of a prolonged summer drought, which probably accounts for the higher estimates for some spring stands.

harvested separately at Hopkinsville. At Princeton all made good yields from the first crop, but Wisconsin 2 and French 2 failed to recover after harvest, while Kentucky 101 and 107 and Tennessee 1 made good second growth.



Fig. 8. Red clovers in the 1927-28 test, Experiment Station farm, Lexington, May 21, 1928. Left, Tennessee clover; right, Kentucky 101. Note thin stand of Tennessee clover, due to winter failure, and the good stand of Kentucky 101. Other clovers from states about Kentucky had stands similar to the Tennessee clover. Compare with Figs. 5, 6 and 7.

Results of the tests at Princeton and Hopkinsville show that unadapted clovers produce good crops in Kentucky when conditions are favorable. However, even under such conditions adapted Kentucky clovers were somewhat superior in stand and yield and produced considerably better second growth.

THE 1929-1930 TESTS

Two tests were sown in 1929; one on the Experiment Station farm at Lexington; the other on the Western Experiment Substation at Princeton.

Test at Lexington. Fifty-six Kentucky clovers, fifty-one of which were reported to have been grown in the state for many years, with twenty-seven clovers from other states and nine¹⁰ from Europe, were sown March 19 to 21, 1929. Excellent stands

¹⁰ One of these, an Italian clover, was not sown in the test series, as it was intended for other studies, but it is reported in Table 6 for information.

of all except Kentucky 119, 148 and 161 were obtained, and each grew vigorously until midsummer. After the middle of July the stands of all clovers except a few of Kentucky origin were



Fig. 9. Left, Indiana; right, Tennessee; red clovers on the Experiment Station farm, Lexington, April 28, 1930. Note the thin stand of Indiana clover. This clover failed during the summer of 1929; practically no winter killing occurred during the following winter. It illustrates, therefore, the extent of summer failing that sometimes occurs in most clovers sown in the state. The Tennessee clover failed somewhat, but it is not noticeable in the photograph.

reduced to some extent by disease (southern anthracnose) (Fig. 9). Losses in stand among domestic and the foreign groups of clovers varied somewhat, being highest in the north-western domestic group, but all were serious, as shown in Table 6. The foreign clovers winterkilled almost completely, and the northern and northwestern domestic clovers killed considerably (Figs. 10, 11, 12). Most Kentucky and southern clovers were winter-hardy, tho a few Kentucky lots winterkilled severely (Table 6). It is significant that none of the Kentucky clovers obtained from commercial sources (Nos. 146, 154, 155, 159 and 160) was among the best in fall and spring stands in this test.

The clovers made very poor growth during the summer of 1930 because of drought and severe but unevenly distributed injury by oat aphid, lesser clover-leaf weevil, red spiders and grasshoppers; consequently the yields of hay obtained (Table 6) are regarded as of less significance than stands in indicating the value of different clovers.

Table 6. Stands and computed yields of red clovers sown on the Experiment Station farm, Lexington, March, 1929.

Group	Percentage Stand ¹¹			Yield of Clover Hay (12% moisture) Lbs. per Acre
	12/11/29	4/8/30	10/10/30	
Kentucky 101	95	95	15	1187
Kentucky 102	75	70	10	1073
Kentucky 103	65	65	5	310
Kentucky 104	70	20	10	433
Kentucky 107	75	70	15	1568
Kentucky 108	75	70	15	1341
Kentucky 109	90	85	15	1414
Kentucky 110	85	75	10	1424
Kentucky 111	75	65	15	1321
Kentucky 112	75	70	15	1310
Kentucky 116	55	50	15	1176
Kentucky 117	75	75	10	1465
Kentucky 118	55	50	10	1507
Kentucky 119	60	60	15	815
Kentucky 120	55	50	20	1238
Kentucky 121	55	55	15	1238
Kentucky 123	80	80	10	1052
Kentucky 124	80	75	15	1558
Kentucky 125	60	50	20	1207
Kentucky 126	60	55	15	1300
Kentucky 127	70	65	10	1950
Kentucky 128	60	60	10	1063
Kentucky 129	70	70	10	722
Kentucky 130	45	35	.....	361
Kentucky 131	75	70	10	1352
Kentucky 132	75	75	15	1001
Kentucky 133	15	10	.....	206
Kentucky 134	60	60	15	1744
Kentucky 135	65	60	20	1702
Kentucky 136	75	45	15	1207
Kentucky 137	75	75	10	948
Kentucky 138	75	70	15	898
Kentucky 139	70	60	15	1084
Kentucky 140	80	75	15	743
Kentucky 141	90	90	15	1764
Kentucky 142	70	45	15	887
Kentucky 143	60	55	15	1475

TABLE 6—Continued.

Group	Percentage Stand ¹¹			Yield of Clover Hay (12% moisture) Lbs. per Acre
	12/11/29	4/8/30	10/10/30	
Kentucky 144	60	60	10	1414
Kentucky 145	70	15	5	836
Kentucky 146	55	50	15	1238
Kentucky 147	60	30	10	887
Kentucky 148	40	15	10	1053
Kentucky 149	75	65	.....	Not harvested ¹²
Kentucky 150	75	65	10	671
Kentucky 151	85	85	10	1104
Kentucky 152	75	70	15	1218
Kentucky 153	70	70	15	1744
Kentucky 154	60	45	10	1507
Kentucky 155	55	25	10	867
Kentucky 156	65	65	10	1682
Kentucky 157	60	60	15	1950
Kentucky 158	80	70	10	1816
Kentucky 159	40	5	.....	650
Kentucky 160	55	45	10	1207
Kentucky 161	15	Failure	.....	.....
Kentucky 162	70	70	15	815
Southern clovers (3) ..	60	55	10	901
Central clovers (5) ..	56	49	8	902
Northern clovers (6) ..	42	24	2	346
Colorado (1)	50	40	10	1269
Northwestern clovers				
(9)	28	12	2	289
Oregon 1 ¹³	35	Failure	.....	.....
Oregon 2 ¹³	60	55	10	1021
Oregon 3 ¹³	30	25	5	588
European (e x c e p t French and Italian)				
(4)	41	9	Failure	26
French (4)	38	Failure	.....	.....
Italian (1)	25	Failure	.....	.....

¹¹ The 100 percent stand had 10 plants per square foot.¹² Hay accidentally taken up before weighing.¹³ Oregon 1, 2 and 3 are considered separately from other northwestern clovers because they were specially chosen by Prof. George Hyslop, of the Oregon Agricultural Experiment Station.

This test, in addition to confirming previous results showing that clovers from other regions are poorly adapted to Kentucky, also proved that some Kentucky clovers are much inferior to others.

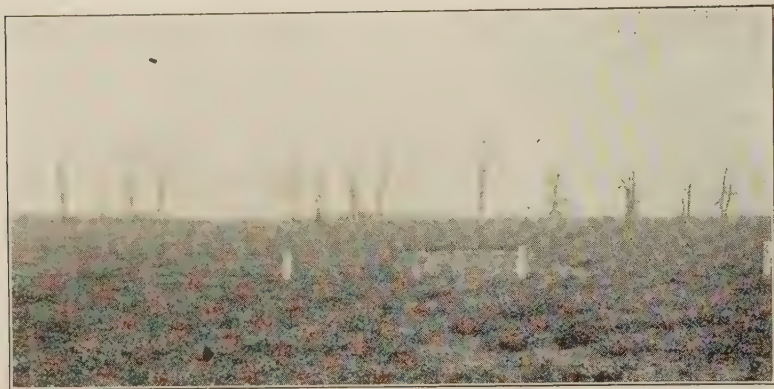


Fig. 10. Left foreground, Tennessee; right foreground, Idaho; red clovers in the 1929-30 test, Experiment Station farm, Lexington, April 28, 1930. The Idaho clover failed seriously during the last half of the summer of 1929 and then winterkilled further. This plot was representative of all Idaho clovers. Tennessee clover, while appearing good, was much thinner than a few Kentucky clovers, including 101 and 107. The bare plot in the background was excellent French clover in July, 1929. It failed much during the late summer and fall; the remaining stand winterkilled. Other foreign plots failed similarly.

Test at Princeton. This test, sown on the Western Experiment Substation March 25, included two foreign, fifteen Kentucky, and twelve clovers from other states. Good stands were obtained, but most of the plants of the northern and northwestern domestic clovers had died before winter, and the central and southern domestic and French clovers lost many plants. Stands of Kentucky clovers were equal to or better than those of other clovers except the southern. The remaining plants of the French, northern and northwestern clovers died during the winter, but the stand of clovers from central and southern states persisted. Several Kentucky clovers winterkilled considerably, but some lost few or no plants (Table 7). Representative differences in spring stands are illustrated in figures 13 and 14.

The clovers were cut, but a windstorm scattered the hay from the cocks before it was weighed. Fall stands (Table 7) of the second year show, however, that many plants of clovers from Kentucky and central and southern states survived the very severe summer drought, tho a few Kentucky lots had practically no plants left.

Results from this test are similar to those obtained at Lexington, showing that clovers from France and northern and northwestern states of the United States sometimes fail in western Kentucky before the second summer.

TABLE 7. Percentage stands and computed yields of red clover lots sown on the Western Experiment Substation farm at Princeton, March 25, 1929.

Group	Percentage Stand ¹⁴			Yield of Air-dry Hay as Lbs. per Acre First Crop
	11/12/29	4/17/30	11/8/30	
Kentucky 101	85	75	30	2400
Kentucky 102	50	30	25	2310
Kentucky 103	70	35	20	1980
Kentucky 104	55	20	10	1095
Kentucky 107	95	75	50	2780
Kentucky 108	85	35	25	2590
Kentucky 112	75	35	5	2295
Kentucky 117	70	60	10	¹⁵
Kentucky 118	90	45	5	3015
Kentucky 121	95	80	30	2430
Kentucky 126	80	60	5	1790
Kentucky 128	85	80	40	1870
Kentucky 140	95	55	20	2565
Kentucky 155	55	5	5	¹⁵
Kentucky 156	95	65	20	3140
Southern clovers (3) ..	65	58	13	2090
Central clovers (2) ..	55	50	13	¹⁵
Northern clovers (2)	22	Failure	-----	-----
Northwestern clovers (2)	40	Failure	-----	-----
French (5)	80	3	Failure	-----

¹⁴ Estimated as percentage of ground cover.

¹⁵ Scattered by storm before time of weighing.



Fig. 11. Left, Kentucky 101; right, Oregon; red clovers in the 1929-30 test, Experiment Station farm, Lexington, April 28, 1930. The Oregon clovers failed badly during the last half of the summer of 1929 and then winterkilled to some extent. This Oregon clover is fairly representative of other Oregon clovers in this test, except No. 2. Kentucky 101 survived the conditions which killed the Oregon clover. The plot had practically a perfect stand.



Fig. 12. Left, Northern; right, Kentucky 146; red clovers in the 1929-30 test, Experiment Station farm, Lexington, April 23, 1930. This northern clover is representative of much of the clover from northern-grown seed sown in Kentucky. It failed principally during the summer of 1929.

SUMMARY OF TESTS

Results of tests conducted from 1926 to 1930 are best summarized by averaging the data (Table 8), tho the values obtained may not be absolutely accurate, as all clovers were not in all tests. Nevertheless, the averages reflect in a compact and clear form the results of practically all tests.

Italian clover has little value for sowing in Kentucky; in these tests it has never made a crop the second year. Other European clovers, on the basis of yields, apparently are worth about one fourth as much as the best Kentucky clovers. They usually fail to make a good first crop in the second year and always fail to produce a second crop.

TABLE 8. Average percentage stands and average computed yields of representative red clovers in Kentucky, 1926-1930.

Group	Average Percentage Stand		Yield of Air-dry Clover Hay as Lbs. per Acre (approximately 12% moisture)		
	Fall of 1st Year	Spring of 2nd Year	First Crop	Second Crop	Total
Kentucky 101	89	82	3035	1385	4420
Kentucky 103	85	49	1760	470	2230
Kentucky 104	76	47	1908	615	2523
Kentucky 107	83	64	2958	950	3908
Southern clovers	75	65	2751	980	3731
Central clovers	72	52	1876	734	2610
Northern clovers	54	34	1790	240	2030
Northwestern clovers	63	21	1360	270	1636
European (e x c e p t					
French and Italian)	64	16	356	.....	356
French	55	19	1261	146	1407
Italian	58	2	Failure	.....	.....

Clovers from the northwestern states are probably worth one third as much as the best Kentucky clovers, based on their average hay production. Our tests show that these clovers frequently fail to produce the first crop the second year and usually produce no second crop worth harvesting. Northern

clovers have rather consistently yielded a little more than one half as much as the best Kentucky clovers, the hay practically all coming from the first crop. They generally produce no second crop worth harvesting. Clovers from Ohio, Indiana,



Fig. 13. Left Michigan; and right, Kentucky 101; red clovers in the 1929-30 test, Western Kentucky Experiment Substation farm, Princeton, on April 18, 1930. The Michigan clover failed during the summer of 1929. Northern clovers frequently fail in Kentucky.

Illinois and Missouri are, on the average, worth about two thirds as much as the best Kentucky clovers. Usually they make both first and second crops the second year, both inferior to the best Kentucky clovers. Southern clovers are worth about four fifths as much as the best Kentucky clovers. They frequently fail to produce first and second crops equal to the Kentucky clover used as a check.

Kentucky clovers may be divided into three overlapping groups. The poorest group consists of clovers sold by the seed trade as Kentucky-grown. None of these is included in Table 8 because they have been insufficiently studied, but our tests show some of them fail to produce in the second year under adverse conditions, while a few, under the same conditions, are satisfac-

tory (Fig. 15). The second group of Kentucky clovers consists of those which have been grown by farmers in the state for several years. These are represented in Table 8 by Kentucky 103 and 104. Usually the members of this group produce good



Fig. 14. Left, Kentucky 101; and right, Idaho; red clovers in the 1929-30 test. Western Kentucky Experiment Substation. Princeton, April 18, 1930. All foreign and northwestern domestic clovers appeared similar to the Idaho shown above. The major portion of failure in the northwestern clovers occurred during the summer of 1929. The foreign clovers failed much during the summer and then winterkilled.

crops the second year. The third group of Kentucky clovers includes those which have been grown in the state for a longer period than those in the second group. These are the most valuable for sowing in Kentucky, as they rarely fail to produce two good crops the second year if properly cultivated and managed. Numbers 101 and 107 are representative of this group. They always produced first and second crops in these tests, even when conditions were so unfavorable that most other clovers failed.

DISCUSSION

It is apparent from the results of nine years' tests described in this bulletin that red clovers from some regions practically

always fail in Kentucky. Clovers from the remainder of the seed-producing regions sometimes yield fairly well and sometimes almost or totally fail. In other words, it is impossible to



Fig. 15. Right, Kentucky red clovers in the 1929-30 test, Experiment Station farm, Lexington, on April 28, 1930. The clover on the left is representative of many Kentucky clovers which have been grown in the state a few years. Kentucky 134 (right) apparently has been grown in the state several years, but its history is unknown.

purchase clover seed on the basis of geographic origin and be certain that the crop will be successful. The only clovers which are certain to produce satisfactorily are those which have been tested experimentally and proved to be adapted. Our tests have discovered two well adapted clovers in Kentucky, and probably there are more.

An adapted clover is one that consistently produces two good crops the second year. Such clovers have been developed in Kentucky because a few farmers have regularly saved their

second crop for seed and sown only that seed. The procedure which has produced Kentucky 101 illustrates the development of adapted clover. The original seed was purchased locally in 1907 and sown in wheat that spring. Seed was harvested from the second crop in 1908, and a sufficient amount was reserved for seeding the entire clover acreage on the farm in 1909 and 1910. No other seed was sown either year. In subsequent years the second crop of the second year was cut for seed if at all possible, even tho the yield was sometimes low. Enough seed for sowing the clover acreage for at least two years was always kept and never mixed with other seed, in fact no other clover seed was sown on the farm. The reaction of the clover to this management is apparent. Each year some plants died, while others lived because they were able to resist conditions which killed the former. In time, this selective process gave a clover able to survive for two years under adverse conditions. Such a clover is adapted to the farm where developed and to a large region having similar conditions.

If an adapted clover consistently produces two good crops the second year, obviously an unadapted clover is one that fails to do so. All clovers therefore are not equally unadapted. Some fail most during the first summer, others during the winter, others during the second spring, and the remainder fail to produce the second crop. Most clovers usually do not fail completely at any one time, except possibly during the winter.

No consideration has been given in these tests to failures from unproductive soils, as all comparisons were made on soils suitable for clover. It is recognized, of course, that failures occur from soil deficiencies, and the reader is referred to Kentucky Agricultural Experiment Station Bulletin 322 for statements concerning soil treatment for clover on the soils of this state.

CONCLUSION

Much clover seed sown in Kentucky is poorly adapted to the state. Some kinds fail the first summer, others fail during the winter, and the remainder fail during the spring or follow-

ing the removal of the hay crop. It appears that the extensive use of these clovers in the state is the important cause of our frequent clover failures. The only way to prevent such failures is to use adapted red clovers in place of clovers of unknown value.

